DOCUMENT RESUME

ED 170 992 EC 115 201

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TITLE The Effects of Training in Discrimination of Pitches on the Ability to Discriminate Speech Sounds in Primary Age Children Classified as Learning Disabled in the Area of Auditory Discrimination.
PUB DATE Apr 79
NOTE 43p.; Paper presented at the Annual International Convention, The Council for Exceptional Children (57th, Dallas, Texas, April 22-27, 1979, Session A-1)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Auditory Discrimination; Auditory Evaluation; *Exceptional Child Research; *Learning Disabilities; *Music; Music Techniques; Music Therapy; *Speech Skills

ABSTRACT

The paper reports on a study in which 64 students (6-9 years old) identified as learning disabled in the area of auditory discrimination were trained to discriminate musical pitches in order to assess effects on speech discrimination. A detailed review of the literature is presented regarding the use of music in remediation, the definition of learning disabilities, and the concept of auditory perception based on J. Wepman's model of perceptual processing. It is explained that treatment consisted of a 5-week program in which Ss were trained to discriminate pairs of successive pitches of no less than a major second and no more than two octaves, and that Ss were required to demonstrate an understanding of the concept of same/different and the ability to discriminate pitches through activities including body movement and verbal response. Data from the Pitch Discrimination Test and Wepman Auditory Discrimination Test are analyzed. Among conclusions drawn is that there is a positive, although small correlation between pitch discrimination and speech sound discrimination which would probably result in improved speech sound discrimination as pitch discrimination is improved. (CL)

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ED170992

THE EFFECTS OF TRAINING IN DISCRIMINATION OF PITCHES ON THE ABILITY TO DISCRIMINATE SPEECH SOUNDS IN PRIMARY AGE CHILDREN CLASSIFIED AS LEARNING DISABLED IN THE AREA OF AUDITORY DISCRIMINATION

by

Barbara L. Baxley

Many children in elementary school have difficulty academically because they have problems which are not easily defined or observed and of which the students themselves, their teachers and their parents may have little, if any, understanding. These problems are known as "learning disabilities," and may manifest themselves in many different ways in any academic area or skill. Learning disabilities are the result of a disorder in one of the basic psychological processes which are involved in using or understanding written or spoken language. They are not primarily the result of a visual, auditory or motor handicap, mental retardation, emotional disturbance or cultural/environmental disadvantage.

It has been hypothesized that children who are found to have a learning disability in the area of auditory processing may be helped by training in and experiences with music activities (Kranyik, 1970; Rejto, 1973; Steele, 1973; Welsbacher, 1975). The purpose of the present study was to determine whether primary age children who are classified as learning disabled in the area of auditory discrimination could be affected in their ability to differentiate among speech sounds by training in differentiation among musical pitches

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Need for the Study

Over the past 15 to 20 years, a significant body of research has been developed which deals with the learning disabled child. The general focus of this body of research has been to determine how this child learns, in what area(s) of learning his disabilities lie, specifically what the disabilities are, and what approach is best used when teaching this type of child. Experts in the field freely admit that the answers to these questions are complex and difficult to obtain and, in most cases, are being obtained slowly. In fact, a theme throughout the literature is a request for more and better research as definite conclusions are sought.

Most tests and programs which have been developed and are being used with learning disabled children place majority emphasis on visual disabilities and give minimal attention to the area of auditory disabilities (Lerner, 1971; Zigmond and Cicci, 1963). However, a common disability of auditory perception and a problem often noted in children who demonstrate difficulty in academic areas is in the area of auditory discrimination (Butler, 1972; Johnson and Myklebust, 1967; Lerner, 1971).

A review of the literature concerned with auditory perceptual processes reveals increased concern in this area over the past few years. Theories and proposed models of perceptual processing have been investigated, and tests have been constructed and standardized based on these. In comparison, however, remediation and treatment have received minimal attention (Lerner, 1971). Recommendation have been abundant, but research into the effectiveness of remediation and/or treatment techniques for children with learning disabilities

has been sparse (Kottler, 1972; Marshall, 1975). It would seem, then, that one of the things needed, in the light of the reality of the classroom, is research into specific techniques toward remediation and/or treatment of subskills of auditory perception.

As has been shown in other areas of handicap, it is believed that music can provide the learning disabled child with experiences in which he can respond at his own level of ability while providing structure which demands that attention be focused on the stimuli presented. Music may be used as a remedial tool which reinforces the work the child is doing in the classroom and, hence, may serve as an aid in concept generalization from one learning situation to another. It may be used to guide the child in learning to structure the stimuli presented to him and to structure his responses to stimuli (Sears, 1968). Since music is an activity enjoyed by most children (Welsbacher, 1975) and since auditory skills are important to the academic achievement of primary age children, techniques employing the use of music to improve auditory perceptual skills, particularly in the area of auditory discrimination, would seem to be an important area of research.

Research which has investigated the effect of training in pitch discrimination on speech sound discrimination has been conducted using several different types of subjects (Dawkins, 1973; Madsen and Geringer, 1976). A search of the literature also revealed several studies in which music was used with learning disabled children (Hurwitz, Wolff, Bortnick, and Kokas, 1975; Rejto, 1973; Steele, 1973; Vernetti and Jacobs, 1972), but no study was found in which the effect

of training in pitch discrimination on the ability of children with learning disabilities to discriminate speech sounds was investigated. It seems, therefore, that the use of music as a source of remedial and treatment techniques with learning disabled children, especially in the area of auditory discrimination, needs to be researched.

Related Literature

The body of literature concerned with the present study covers several areas: first, the problem of defining learning disabilities; second, the development of auditory perception and its relation to academic skills; and last, the relationship of music to auditory perception and learning disabilities. The problem of defining learning disabilities lies in the seeming inability of various groups and persons to agree what criteria should be used to describe this group of children (McDonald, 1968; Gearheart, 1973; Cruickshank, 1977).

In 1970, Congress passed Public Law 91-230 which included the following definition of learning disabilities (LD):

> The term "children with specific learning disabilities" means those children who have a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which disorder may manifest itself in imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculation. Such disorders include such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. Such term does not include children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, or mental retardation, of emotional disturbance, or of environmental disadvantage. (United States, 1970, p. 177)

Because this definition is part of the federal law which determines the legal aspects of the field of LD, it is often used as a standard for determining the acceptability of other definitions. Some state education agencies have adopted this definition without modification;

others have changed it to some extent (Mercer, Fergnone, and Wolking, 1976). At the present time, the Commissioner of Education of the Department of Health, Education, and Welfare (DHEW) (United States, 1976) is seeking to make this definition universally operational and to determine what, if any, changes need to be made.

The criteria most commonly included in definitions of LD are (1) determination that a LD is the child's primary handicap; (2) a statement that the child's IQ is average or above; (3) exclusion of children with mental retardation, cultural disadvantage, emotional disturbance or visual, auditory or motor handicap from the category of LD; and (4) some statement of the possible causes of LD (Gearheart, 1973; Vaughn and Hodges, 1973; Chalfant and King, 1976; Mercer, et al., 1976; United States, 1976). The literature includes studies which discuss the various components that have been included in the definitions set forth by various experts and those commonly in use (Mercer, et al., 1976), and studies which present the results of surveys of the opinions of personnel involved with LD children (Vaughn and Hodges, 1973). From the literature, it is clear that, while some general criteria have been agreed upon, there is still division among those in the field of LD as to the criteria to be used to define a learning disability and to determine if a child has a learning disability.

The discussion of auditory perception is based on Wepman's model of perceptual processing (Wepman, 1968, 1975). This model is presented in Figure 1 and is described by Wepman (1968) as follows:

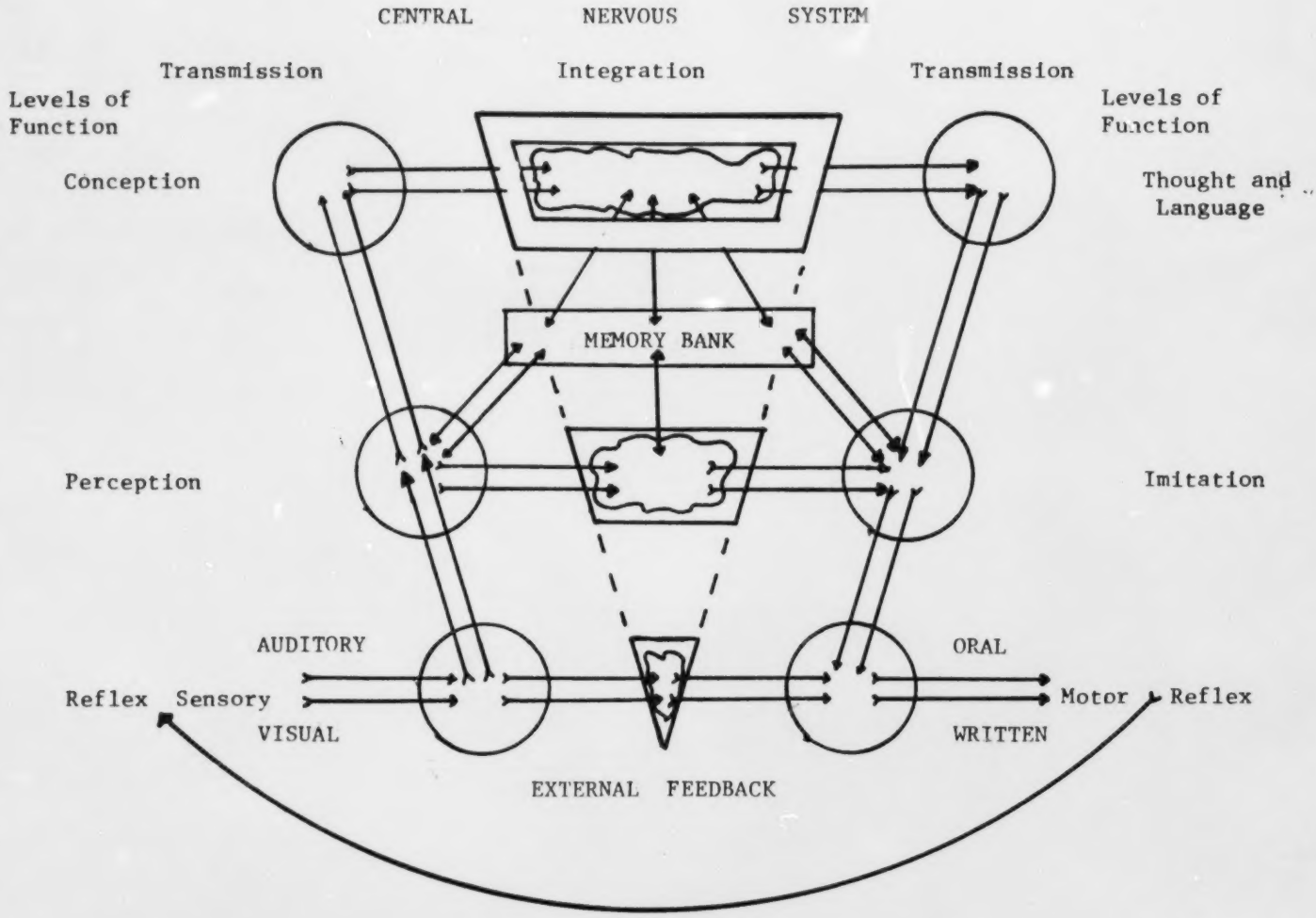

Figure 1. An Operational Diagram of Levels of Function in the Central Nervous System.

> The hypothetical model . . . stresses two features of the structural base underlying the learning act. First, it emphasizes the unique modality-bound nature of all sensory input patterns. Second, it elaborates the hierarchical, yet interrelated, nature of the maturation and development of the neural system. . . .
>
> . . . . . .
>
> [It] is designed to illustrate both the modality-bound nature of the input and output signals and the increasing levels of complexity of function as the individual matures. (p. 1)

According to his theory, each individual has a particular learning style in which either the auditory, visual or tactual/kinesthetic modality plays the major role. As each of the modalities develops at its own rate, it interacts with the others at the same time. Therefore, if one modality develops more quickly than the others, it will be the dominant modality of the individual's learning style.

Perceptual processes are used in learning the alphabets of phonemes and graphemes necessary to language and reading. Bannatyne (1968) suggests that when a child begins to read, he should be able simply to integrate, i.e., to associate, the auditory alphabet of sounds he has established with the visual alphabet of graphemes he is learning. If auditory perception is poor or immature in any area, the child will not be able to integrate these sufficiently because of the limited alphabet of sounds he possesses and will have difficulty learning to read and/or spell (also see Wepman, 1972; Zigmond and Cicci, 1968). In other words, the auditory perceptual processes are a basic part of the foundation for the conceptual processes of reading and spelling. Swartz and Tracey (1972) cite auditory perceptual processes as the major underlying channel through which speech and language are acquired (learned) and, therefore, the major factor in learning to read.

Morency (1968) and Morency and Wepman (1973) found that both auditory and visual perceptual abilities are significantly related to almost every subtest of the Monroe Achievement Test. They concluded that a child's modality of learning is extremely important to whether or not he will learn by the method used to teach him and further, that children should be grouped according to preferred modality, especially in the primary grades.

Bateman (1968) studied a group of high socioeconomic frist graders with average or above average intelligence whom she grouped according to learning modality and method of instruction. She found that the auditory method was significantly superior for subjects taught according to preferred modality ($p < .01$) as well as those not ($p < .05$) and also that there was no statistically significant interaction between the subjects' preferred modality and the method used for instruction. These surprising results led her to conclude that, at least with this homogeneous, above average intelligence group, the auditory method was superior to the visual method of instruction for both reading and spelling regardless of preferred modality.

Flower (1968) states that, "Auditory processes play a major role in the mastery of [reading]" (p. 21). He describes the reading act as "the reconstruction of a spoken message from the printed page" (p. 21) by transforming graphemes to phonemes and then into spoken words.

Rechner and Wilson (1967) found that speech sound discrimination ability of first grade students had a significant effect ($p < .05$) on the results of scores on the Illinois Test of Psycholinguistic Abilities (ITPA) but that speech articulation ability did not. They

concluded that subjects with deviant speech sound discrimination, whether their speech articulation was deviant or not, scored significantly poorer ($p < .05$) on the auditory-vocal subtests of the ITPA than those with normal discrimination ability. Golden and Steiner (1969) concluded that the second-grade subjects classified as poor readers for their study had poorer auditory discrimination skills than the good readers.

From the literature reviewed, it is apparent that auditory discrimination is an essential skill in developing speech/language skills, including reading and spelling. Slow maturation or difficulties in the auditory modality can cause problems in speech and/or in acquiring reading skills. The probability of problems in auditory discrimination leading to problems in the acquisition of reading skills has been indicated in the research literature. Children, especially in the primary grades, who are experiencing reading problems very likely are either immature or impaired in the area of auditory discrimination.

In his outline of "Processes in Music Therapy, " Sears (1968) discusses the need for "experience within structure." Applied to the child with perceptual processing problems/disabilities, one can understand that the basic difficulty lies in the inability to define the structure of the stimuli. Stimuli which cannot be discriminated, i.e., sorted according to likeness and difference, cannot be structured for recall and/or sequencing. The learning disabled child with auditory perceptual disability needs experience in discriminating

the auditory stimuli which he receives. He must learn to adapt the ability he has to sort sounds according to sameness and difference and to structure the sounds for meaning. Welsbacher (1975) states:

> The sounds of music comprise an area or medium that is potently available to the learning disabled child. Music is the organization of selected sounds. Understanding the nature and value of music <u>is</u> learning the selection and organization of sound that is music and learning to select and organize those sounds to create or recreate music. (p. 138)

The music therapist is responsible for guiding the child into generalizing the understanding of selection and organization of sounds to other academic areas which also require the selection and organization of sounds. In this way, music becomes the catalyst for learning academic skills.

According to Sears (1968), "Music demands increased sensory usage and discrimination" (p. 33). Discrimination must begin with the skill of sorting sound stimuli according to likeness and difference on a gross (environmental) level, e.g., a door bell from a car horn, wind from rain, etc. It is refined along a continuum to the finest sound of the voiceless consonant phonemes. Granted, this is an oversimplification of the process; however, within the process the child must learn to discriminate sounds, including pitch, on a finer and finer level until he is able to discriminate all of the speech sounds he hears. These speech sounds become the alphabet of sounds he must integrate with the alphabet of graphemes he uses in learning to read and spell.

The literature reporting the use of music with learning disabilities was found to be very sparse. Therefore, it was necessary to search for literature from the areas of education (specifically, reading) and speech therapy which reports the use of music as a means of

achieving improvement in problems and/or disabilities that seem to relate to the learning disabled child.

Since speech and language development is basically effected by auditory discrimination, i.e., the ability to distinguish between sounds on a continuum of gross to fine differences in sounds, one area of discrimination which may have important consequences is the area of pitch discrimination. A review of the literature made apparent the fact that research comparing pitch discrimination to speech sound discrimination has been related almost exclusively to articulation defects. In fact, only research in this area was found. Reports of studies in the area of speech have indicated mixed results, but seem to indicate that music may be helpful, particularly when used with articulation problems.

Weiner (1967) suggests in his review of the literature on the relationship of auditory discrimination to articulation defects: "[A] clearly relevant area of study that has remained unintegrated with the work on auditory discrimination is that linking pitch discrimination to articulation" (p. 26). He notes that the literature he reviewed indicates "a meaningful relationship between the phonomena" (p. 26).

From his investigation of normal, articulation defective and hearing impaired children, Bradley (1959) concluded that pitch discrimination is a factor in the development of speech and language for hearing impaired children and further suggested that it may also be a contributing factor for children with articulation defects.

Sommers, Meyer, and Furlong (1969) concluded that it is possible that the amount of ability to discriminate pitches is an important

variable in performance on auditory discrimination tasks for children with mild articulation problems. Further, they concluded that performance on auditory discrimination tests of children with articulation problems is related to the degree of the defect and that there is evidence that some auditory perceptual skills are related to the degree of articulation defect and thus, degree of articulation defect is an important variable in such studies.

Bergendal and Talo (1969) compared a group of seven first grade children with delayed speech of varying degrees with seven normal first graders. All subjects were administered the Seashore Measures of Musical Talents. In general, it was found that the experimental group scored more poorly on all subtests than the control group, the most conspicuous difference being in the area of tonal memory. The scores of each experimental subject were compared with the various speech defects of the group. Some correlation was noted between pitch scores and quality errors in the vowel system; however, the authors agreed that "no far reaching conclusions can be drawn" (p. 30) from the findings of this research. From his study of children with articulation defects, Kuper (1972) concluded that the musical training which he utilized, consisting of training in pitch and rhythm discrimination, "may have had as beneficial effect on articulation as actual speech correction" (p. 171).

Results of research indicate that programs of instruction in music reading skills may enhance the learning of reading skills and also, that pairing tonal cues with instruction in word discrimination improves speech discrimination. McIntyre (1975) discusses the theory of using music as a catalyst in motivating primary age children to learn

reading, manuscript writing and computation. He feels that music is the most logical subject for doing so because it cuts across the skills which are necessary to the learning experience of the primary student. However, music is usually taught as a separate subject apart from academic skills, although it is an integral part of the everyday life of our society. Since music integrates both the affective and cognitive domains, McIntyre sees it as an ideal catalyst for learning academic skills. Although writing before him, Movsesian (1967) was dealing with a part of McIntyre's theory, specifically learning reading skills at the primary grade level. He concluded that, when taught music reading skills concurrently with basic reading skills, first-grade students become significantly more efficient in developing reading comprehension, but not in reading vocabulary, and second-grade students become more efficient in developing reading vocabulary and reading comprehension. Results did not indicate that this was true for third-grade students.

Berman (1976) developed a nonverbal reading prototype through the application of music which paralleled the verbal decoding process. From the prototype she developed a nonverbal auditory-visual (A-V) instructional program which she used to examine the learning profiles of good and poor readers, seeking to identify specifically the A-V difficulties experienced by poor readers. From her findings, she concluded that A-V pairing difficulties of poor readers are only symptoms of basic intra-modal auditory difficulties that need to be overcome. Instructionally, results lend support to perceptual skills training and suggest that the application of a nonverbal reading prototype can be included in reading programs as training in nonverbal reading subskills and also

that music could be used as a means to achieve additional academic goals.

Results from three other studies were quite similar when tonal discrimination was paired with language discrimination for instruction. Madsen, Madsen, and Michel (1975) paired tonal stimuli with words to investigate the improvement in discrimination of word pairs. Results indicated that auditory discrimination, as measured by the Wepman Auditory Discrimination Test, was significantly improved as a result of training using tonal cues with word pairs and stories set to melodies. Therefore, the authors concluded that the use of simple tonal pairings significantly increased the subjects' ability to discriminate between similar sounding words.

Madsen and Geringer (1976) studied the "effect of subject-matter gain in relationship to choice of reinforcement" with kindergarten children (p. 155). Subjects were matched and then randomly assigned to four groups: (1) TV music lessons, (2) free play, (3) choice of TV music lessons or free play and (4) no-contact control. Subjects in the control group were allowed to play outside during the treatment sessions. Instruction consisted of the use of tonal cues as an aid to facilitating discrimination of word pairs. Treatment consisted of the reinforcement activities designated by the group titles. Results indicated that treatment groups differed significantly ($p < .05$) from the contact-control group but not from each other. Therefore, it was concluded that treatment alone was responsible for the gain scores obtained.

Dawkins (1973) used storied and stories set to music as experimental training. From the results obtained, he concluded that the use

of music in phonics instruction enhances word discrimination skills and that auditory discrimination activities using music have a more positive effect on test scores than those activities which do not employ music.

Applying techniques using music in the remediation of learning disabilities evidently has not been widely reported. A review of the literature reveals a paucity of studies which combine the use of music, in any way, with learning disabled children.

Two reports of case studies were found. Rejto (1973) describes a case study of a seven-year-old boy with learning disabilities who studied piano privately. He was enrolled in speech therapy in school, but received no other special tutoring during the time he was enrolled for piano lessons. Pretests were given approximately six months before piano lessons began. Post-tests were given after about six months of lessons. The subject gained 15 points on the WISC full scale score, from 131 to 146. Scores on most of the various subtests of the standardized tests administered showed gains between two and four years. The author concluded that music training was responsible for the gains in the test scores.

Steele (1973) described the behavior modification techniques used with a 12-year-old learning disabled girl. Although no statistics were reported, the author noted that long-range goals were attained by the subject.

Vernetti and Jacobs (1972) used classical music to mask background noise in learning disabilities classes during work on mathematics worksheets. They found no significant difference in performance between conditions with music and conditions without music, and concluded that performance in mathematics by learning disabled children is not affected by music or masking noise.

Hurwitz, Wolff, Hortnick, and Kokas (1975) studied normal primary grade subjects who had been instructed in the Kodaly program of music instruction and those who had not. In two related studies, they investigated the effect of Kodaly instruction on (1) sequencing skills and spatial abilities, and (2) academic achievement patterns of normal American children from middle class communities. Based on the results obtained from these normal subjects, the authors concluded that learning disabled children may benefit from the Kodaly program in the areas of rhythm and spatial organization and transfer of learning, and suggested research in these areas.

Although reports of research in which the use of music as a remedial tool with LD children has been investigated are exiguous, results indicate that music as a remedial tool may be used successfully to strengthen the academic weakness of LD children. Therefore, it seems appropriate to conclude that music can be used effectively with learning disabled children as a remedial tool.

Design of the Study

Subjects for the present study were drawn from the remedial resource classrooms of 19 elementary schools of a public school system in North Texas. Sixty-four students, ages six to nine years, were selected as participants on the basis of IQ score, age, reading level and grade level. All subjects had been identified by the school district as learning disabled in the area of auditory discrimination on the basis of guidelines set by the Texas Education Agency (1973). Twenty-eight subjects from 12 schools were designated as Control group, and 36 subjects from seven schools were designated as Experimental group. This division into groups was made on the basis of which

school the subjects attended; hence, schools with the largest number of subjects were chosen as experimental settings.

These two groups were divided into four subgroups according to the Solomon Four-Group design (Campbell and Stanley, 1963). The design is as follows:

Group I:	O_1	X	O_2
Group II:	O_3		O_4
Group III:		X	O_5
Group IV:			O_6

where O_1 and O_3 indicate pretest observations, O_2, O_4, O_5 and O_6 indicate post-test observations and X indicates treatment. Thus, Groups I and III were Experimental Conditions, Groups II and IV Control. This design was used because the effects of testing, the effects of treatment and the interaction of testing and treatment are determinable by comparing Groups I and II with Groups III and IV.

> In this way, not only is generalizability increased, but in addition, the effect of X is replicated in four different fashions: $O_2 > O_1$, $O_2 > O_4$, $O_5 > O_6$, and $O_5 > O_3$. The actual instabilities of experimentation are such that if these comparisons are in agreement, the strength of the inference is greatly increased. (Campbell and Stanley, 1963, p. 25)

In addition, one can test for testing-by-treatment interaction, and therefore, one is better able to interpret past and future pretest-post-test control group designs due to the fact that a better control is made of sources of internal and external validity.

The mean IQ score, age, reading level and grade level of each of the four groups in the experimental design are presented in Table 1. A rather even distribution is seen among the groups in each of the four organismic variables. The range of mean IQ scores was from 91.1 in Group III to 98.4 in Group I. The means of ages ranged from 7.8 in

Table 1

Mean IQ Score, Age, Reading Level and Grade Level of Each Group and the Total Sample

Group	IQ	Age	Reading Level	Grade Level
Group I[a]	98.4	7.8	1.4	2.1
Group II[b]	95.4	8.5	2.0	2.8
Group III[a]	91.1	7.8	1.4	2.0
Group IV[b]	96.6	8.1	1.2	2.1
Total Sample	94.6	8.0	1.5	2.2

[a]Treatment Group
[b]Control Group

Groups I and III to 8.5 in Group II. The mean scores for reading level ranged from 1.2 in Group IV to 2.0 in Group II, and for mean grade levels, from 2.0 in Group III to 2.8 in Group II. The means for the total sample indicate a typical subject had an IQ score of 94.6, was 8.0 years of age, had a reading level of 1.5 and was at a grade level of 2.2.

Settings for both testing and treatment varied among the 19 schools involved. The typical setting for testing sessions was an area or corner of the remedial resource classroom, although a separate room was available in some situations. For the seven schools involved in the Experimental Condition, settings consisted of rooms separated from other classes for five of the groups; for the other two groups, classrooms were used in which other groups were present at the time of the treatment sessions.

Subjects were given the Pitch Discrimination (PD) Test which was author-constructed for the purposes of the present study and the Wepman Auditory Discrimination Test, Revised (1973), Form IA, as pre- and

post-tests. Tests were tape-recorded for uniformity of administration and played back using a Sony Model TC 270 reel-to-reel tape recorder and Pickering Model 4955 headphones. Subjects were tested individually using an examiner to record responses to test items. Post-tests were given approximately one month after pretests.

Treatment consisted of ten sessions, 15 to 20 minutes in length, which were conducted over a five-week period. Experimental subjects were divided into seven groups according to the school which they attended and were trained by the experimenter to discriminate pairs of successive pitches of no less than a major second and no more than two octaves. Subjects were required to demonstrate an understanding of the concept of same/different and the ability to discriminate pitches through activities which included body movement or verbal response. Control groups received no training.

Hypotheses

The following hypotheses, stated in the null form, were investigated. These hypotheses were tested at the .05 level of confidence.

H_0: 1. There is no difference between the post-test scores on the Pitch Discrimination (PD) Test of subjects receiving pretest (Groups I and II) and those not (Groups III and IV).

H_0: 2. There is no difference between the post-test scores on the Pitch Discrimination (PD) Test of subjects receiving treatment (Groups I and III) and those not (Groups II and IV).

H_0: 3. There is no treatment-pretesting interaction effect on the post-test scores of all groups (I-IV) on the Pitch Discrimination (PD) Test.

H_0: 4. There is no difference in post-test scores of all groups (I-IV) on the Pitch Discrimination (PD) Test due to the effects of IQ scores, age, reading level and grade level.

H_0: 5. There is no difference between the post-test scores on the Wepman Auditory Discrimination Test of subjects receiving pretests (Groups I and II) and those not (Groups III and IV).

H_0: 6. There is no difference between the post-test scores on the Wepman Auditory Discrimination Test of subjects receiving treatment (Groups I and III) and those not (Groups II and IV).

H_0: 7. There is no treatment-pretesting interaction effect on the post-test scores of all groups (I-IV) on the Wepman Auditory Discrimination Test.

H_0: 8. There is no difference in post-test scores of all groups (I-IV) on the Wepman Auditory Discrimination Test due to the effects of IQ scores, age, reading level and grade level.

H_0: 9. There is no positive correlation between scores on the Pitch Discrimination (PD) Test and scores on the Wepman Auditory Discrimination Test.

Evaluation of the Data

Validity and Reliability of the Pitch Discrimination (PD) Test. Preliminary to other analyses of the data, the number of items which constituted the PD Test was reduced from 60 to 40 items. This was considered necessary because the ability of some items to discriminate those subjects who could hear differences in pitches was questioned. The purpose of the PD Test was to measure the ability of the subject to hear differences in pitches. There were several basic assumptions on which the test depended: (1) that subjects understood the concept of

sameness/difference in pitches, (2) that subjects could perceive at least "large" differences in pitch, and (3) that test items could be used to determine which subjects could hear differences in pitch. The deletion of items was accomplished in two steps: first, determination of items which were too easy; and second, determination of items which were too difficult. The determination of which items to exclude was made on the basis of the results from Chi-square tests of independence between high/low scoring groups and correct/incorrect responses for each item.

By correcting the PD Test, it was believed that it was made more valid; i.e., it did measure the ability of subjects to discriminate pitches. Validity was based on judgment (face and content validity) since each item was carefully chosen according to how it related to the property being measured, i.e., pitch discrimination. Also, the moderately high correlation coefficient of .69 for the corrected version probably indicates relatively high validity. Support for this assumption is found in Kerlinger (1964) who points out that theoretically and empirically "validity and reliability are close variance relations" (p. 456). Therefore, it must be assumed that the corrected version of the PD Test has at least good face and/or content validity and that it measures what it purports to measure, that is, pitch discrimination.

The resulting corrected scores were used for all further evaluation of the data unless otherwise stated. The Wepman Auditory Discrimination Test (1973) has normative data for validity and reliability reported in the test manual.

Scores from Group II (O_3 and O_4) were used to determine the test-retest reliability of the PD Test, because it was the only group which

received pre- and post-tests without treatment. Using the raw test data, the Pearson product-moment correlation technique was utilized, which yielded a reliability coefficient of .66. Using the corrected scores, the Pearson correlation yielded a reliability coefficient of .69. This test-retest reliability is considered to be moderate.

The source of stimuli for items on the PD Test was either guitar or resonator bells. The stimulus to be used for each item was decided randomly by the toss of a coin which resulted in 30 items played on guitar and 30 on resonator bells. Items were grouped by stimulus and a Spearman rank-correlation done using the post-test scores of all four groups (O_2, O_4, O_5 and O_6). The resulting correlation coefficient was .72, a fairly strong positive relationship.

Relationship between the Pitch Discrimination (PD) Test and the Wepman Test. The related literature cites the possibility of a positive relationship between pitch discrimination and speech sound discrimination. This posed a question: Do these two abilities, as measured by these two types of tests, have a positive correlation? The answer was considered important to the basic purpose of the present study: Training in pitch discrimination will improve speech sound discrimination. Using the scores obtained from O_1, O_3 and O_6, the Pearson product-moment correlation method was used to determine the relationship between the scores on the Wepman test and those on the PD Test. The derived correlation coefficient was .24 which indicates that there is a small positive correlation. Thus, only a slight relationship existed between the two scores, which is illustrated in Figure 2.

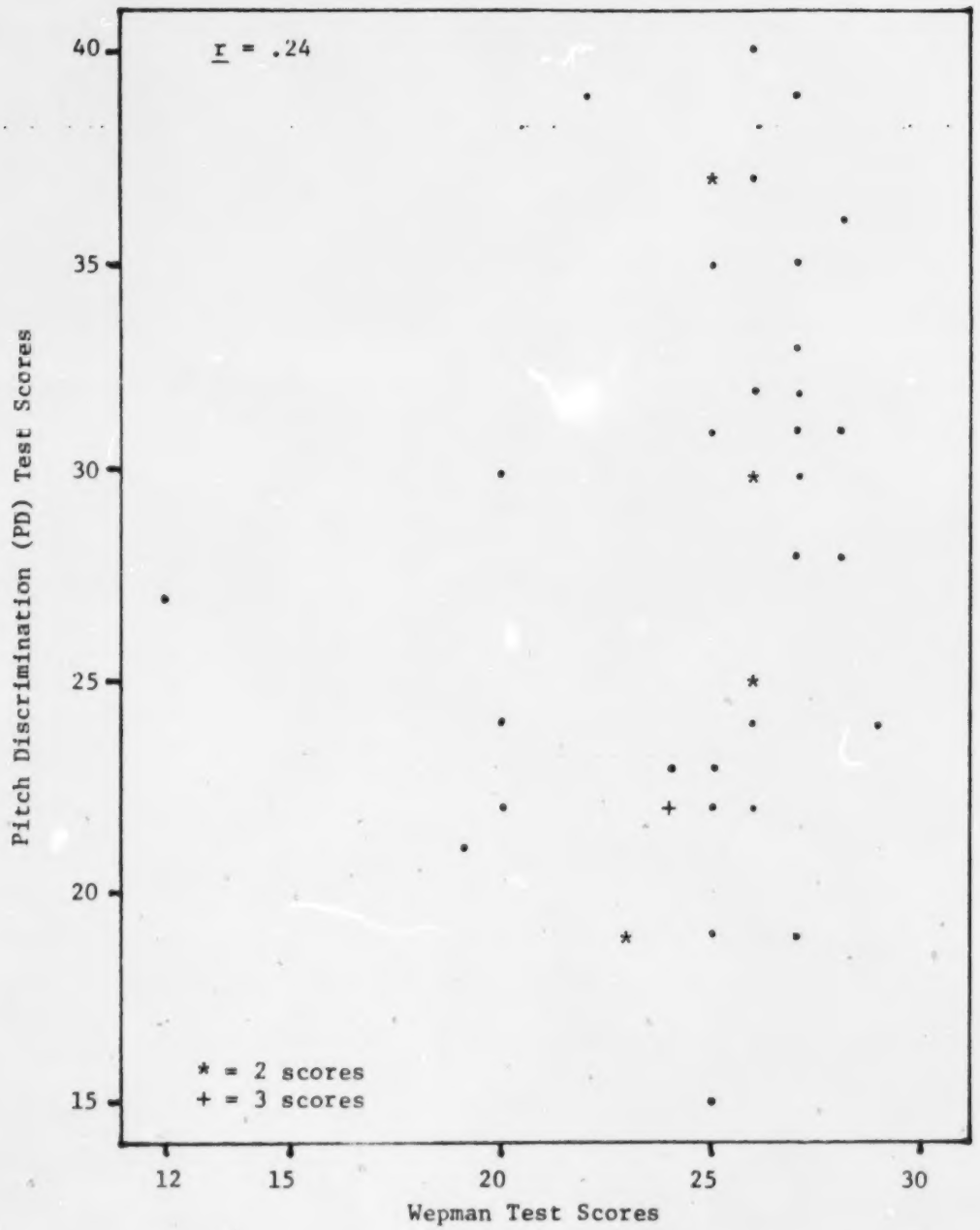

Figure 2. Scattergram of the post-test scores on the Wepman test and the Pitch Discrimination (PD) Test for all subjects.

Analysis of the Pitch Discrimination (PD) Test Data. An analysis of variance was done using the data from all four groups to determine the effects on post-test scores of the main effects of pretesting, the main effects of treatment and the interaction effects of testing with treatment. The summary of the analysis of variance appears in Table 2. These data reveal that for the main effects of pretesting, the derived F score of 4.11 was significant ($p=.05$). This is indicates that post-test scores of subjects having the pretest were significantly different from those of subjects not having the pretest. The results of the main effects of treatment revealed a derived F score of 7.15 which was significant ($p=.01$) and indicates that treatment significantly affected post-test scores. The derived F score for the effects of interaction was 3.76 which was significant ($p=.05$). These results indicate that the interaction between the main effects of pretesting and the main effects of treatment did cause a significant difference in post-test scores. As a consequence, an analysis of covariance was done to determine if any of the covariates had significantly effected post-test scores. The covariates used were IQ score, age, reading level and grade level. (Data on the covariates were not available for four subjects due to the policy of the school in which the subjects were enrolled.)

The results of the analysis of covariance are presented in Table 3 and indicate that three of the covariates did not significantly affect the post-test scores ($p > .05$). The derived F score of 5.80 for age was significant ($p=.02$) and indicates that age of the subject significantly affected post-test scores. There are also some interesting differences in the main effects and the interaction. The derived F

Table 2

Summary of the Analysis of Variance of the Pitch Discrimination (PD) Test Scores

Source of Variance	Sum of Squares	df	Mean Squares	F	Significance of F
Effects:					
Pretest/ No Pretest[a]	146.40	1	146.40	4.11	.05
Treatment/ No Treatment[b]	254.74	1	254.74	7.15	.01
Interaction	133.94	1	133.94	3.76	.05
Residual	1738.98	60	28.98		
Total	2046.86	63	32.49		

[a]Groups I (O_2) and II (O_4)/Groups III (O_5) and IV (O_6)
[b]Groups I (O_2) and III (O_5)/Groups II (O_4) and IV (O_6)

score for the main effects of pretesting was 2.35, which was nonsignificant (p .05). This indicates that in the absence of the effects of the covariates, the effects of pretesting no longer caused a difference in post-test scores. Results revealed a derived F score of 2.42 for the main effects of treatment, which was nonsignificant ($p > .05$) and which indicated the effects of treatment on the post-test scores are not significant in the absence of the covariate effects. The results for the interaction effects reveal a derived F score of 3.93, which is significant ($p = .05$). These results indicate that there is significant interaction between the main effects of pretesting and the main effects of treatment and that age significantly affected post-test scores.

Because of the significant interaction, it was deemed necessary to determine exactly where the cause of the interaction was. Therefore, t-tests were run. The results of the t-tests indicated several things:

Table 3

Summary of the Analysis of Covariance of the Pitch Discrimination (PD) Test Using IQ Scores, Age, Reading Level and Grade Level as Covariates

Source of Variance	Sum of Squares	df	Mean Squares	F	Significance of F
Covariates:					
IQ Score	7.64	1	7.64	.21	.65
Age	208.33	1	208.33	5.80	.02
Reading Level	23.44	1	23.44	.65	.42
Grade Level	38.31	1	38.31	1.07	.31
Effects:					
Pretest/ No Pretest[a]	84.62	1	84.62	2.35	.13
Treatment/ No Treatment[b]	86.88	1	86.88	2.42	.13
Interaction	141.27	1	141.27	3.93	.05
Residual	1869.08	52	35.94		
Total	2461.00	59	41.71		

[a]Groups I (O_2) and II (O_4)/Groups III (O_5) and IV (O_6)
[b]Groups I (O_2) and III (O_5)/Groups II (O_4) and IV (O_6)

1. When treatment is present (O_2 vs. O_5), pretesting does not seem to have a significant effect ($p=.83$) on post-test scores;
2. When pretesting is present (O_2 vs. O_4), treatment does not seem to have a significant effect ($p=.91$) on post-test scores;
3. In the absence of treatment (O_4 vs. O_6), pretesting seems to have a significant effect ($p=.01$) on post-test scores; and
4. In the absence of pretesting (O_5 vs. O_6), treatment seems to have a significant effect ($p=.002$) on post-test scores.

Cross-tabulations of low, medium and high scoring groups versus pretest/no pretest and treatment/no treatment confirmed these results.

Analysis of the Wepman Test Data. Using the post-test scores for all four groups (O_2, O_4, O_5 and O_6), an analysis of variance was done to determine the effects on post-test scores of the main effects of pretesting, the main effects of treatment and the interaction of testing with treatment. Table 4 gives the summary of the analysis of variance. For the main effects of pretesting, the derived F score was 7.01 which was significant ($p < .05$), indicating that pretesting significantly affected post-test scores. For the main effects of treatment, the derived F score was .58 which was not significant ($p > .05$) and indicated that treatment did not have a significant effect on post-test scores. The derived F score for the interaction was 1.23 which was not significant; this score indicates that there was no significant interaction effects between pretesting and treatment.

Table 4

Summary of the Analysis of Variance
of the Scores on the Wepman Test

Source of Variance	Sum of Squares	df	Mean Squares	F	Significance of F
Effects:					
Pretest/ No Pretest[a]	64.17	1	64.17	7.01	.01
Treatment/ No Treatment[b]	5.32	1	5.32	.58	.45
Interaction	11.29	1	11.29	1.23	.27
Residual	549.29	60	9.15		
Total	628.94	63	9.98		

[a]Groups I (O_2) and II (O_4)/Groups III (O_5) and IV (O_6).
[b]Groups I (O_2) and III (O_5)/Groups II (O_4) and IV (O_6).

As with the PD Test, an analysis of covariance was run using IQ scores, age, reading level and grade level as the covariates. The summary of the analysis of covariance is presented in Table 5. These data reveal that none of the covariates significantly affected ($p > .05$) post-test scores.

Table 5

Summary of the Analysis of Covariance of Scores on the Wepman Test Using IQ Scores, Age, Reading Level and Grade Level as Covariates

Source of Variance	Sum of Squares	df	Mean Squares	F	Significance of F
Covariates:					
IQ Scores	21.34	1	21.34	2.41	.13
Age	.02	1	.02	.002	.96
Reading Level	.89	1	.89	.10	.75
Grade Level	7.74	1	7.74	.87	.35
Effects:					
Pretest/ No Pretest[a]	34.65	1	34.65	3.91	.05
Treatment/ No Treatment[b]	12.44	1	12.44	1.40	.24
Interaction	9.14	1	9.14	1.03	.31
Residual	460.57	52	8.86		
Total	609.93	59	10.34		

[a]Groups I (O_2) and II (O_4)/Groups III (O_5) and IV (O_6).
[b]Groups I (O_2) and III (O_5)/Groups II (O_4) and IV (O_6).

The derived F score for the main effects of pretesting was 3.91 and was significant at $p=.05$; this indicated that the pretest significantly affected post-test scores. For the main effects of treatment, the derived F score was 1.40 which was not significant ($p > .05$). For interaction the derived F score was 1.03 and was not significant ($p > .05$). These data indicate that post-test scores were not significantly affected by the treatment and that there was no significant

interaction between testing and treatment.

Since the main effects of pretesting, the main effects of treatment and the interaction of testing with treatment were clearly defined by the analysis of variance and the analysis of covariance, it was not deemed necessary to do t-tests for the Wepman test data. However, the effects of pretesting and treatment on the post-test scores which were revealed by the cross-tabulations were considered to be of interest:

1. Subjects who took the pretest (O_2 vs. O_5) seemed to score higher on the post-test than those who did not (O_5 vs. O_6).
2. Subjects who received the pretest with treatment (O_2) tended to score higher on the post-test whereas the scores of those who received no pretest with treatment (O_5) tended to be fairly evenly distributed.
3. Subjects who received the pretest with no treatment (O_4) tended to score higher on the post-test than those who received no pretest with no treatment (O_6).

Conclusions

There were nine hypotheses presented for the study. These hypotheses are restructured, where appropriate, to reflect the findings drawn from the results.

H1: Pretesting does affect post-test scores on the PD Test. There is a difference in post-test scores on the PD Test due to the effects of pretesting.

H2: Treatment does affect post-test scores on the PD Test. There is a difference in post-test scores on the PD Test due to the effects of treatment.

H3: There is interaction between testing and treatment. There is a difference in post-test scores on the PD Test due to interaction between pretesting and treatment.

H4: The covariates of IQ score, reading level and grade level have no affect on post-test scores of the PD Test, but the covariate of age does. There is no difference on post-test scores on the PD Test due to the effects of IQ, reading level or grade level of the subjects but there is a difference due to the effect of age.

H5: Pretesting has an affect on post-test scores on the Wepman test. The difference in post-test scores on the Wepman test is due to the effect of pretesting.

H6: Treatment does not have an affect on post-test scores of the Wepman test. The difference in post-test scores on the Wepman test is not due to the effects of treatment.

H7: There is no interaction between testing and treatment. There is no difference in post-test scores on the Wepman test due to interaction between pretesting and treatment.

H8: The covariates of IQ score, age, reading level and grade level have no effect on post-test scores of the Wepman test. Differences in post-test scores on the Wepman test were not due to the effects of IQ, age, reading level or grade level.

H9: There is a small positive correlation between pitch discrimination as measured by the PD Test and speech sound discrimination as measured by the Wepman test. The prediction of scores on the Wepman test may not be made from scores on the PD Test, i.e., a high score on the PD Test does not necessarily indicate a high score on the Wepman test, because of $\underline{r}=.24$.

Discussion and Recommendations

Selection of Subjects. All subjects for the present study were enrolled in the Plan A program of the Special Education Department of a public school system in Texas. Subjects were chosen on the basis of IQ scores, age, reading level and grade level. Although these criteria narrowed the range of available subjects making it difficult to find the number desired for the study, it is believed that the criteria were still not specific enough to identify those subjects who would benefit most from training in pitch discrimination as a remedial tool in the area of auditory discrimination. For any further research, it is recommended that the age range be limited to a one-year span in an attempt to control for effects of maturation in the areas of auditory and/or academic skills. The use of several tests and/or subtests of auditory skills is also recommended to guarantee a homogeneous group of subjects. It has been noted that discrimination of speech sounds does not reach maturation until the ninth year (Weaver and Rutherford, 1974; Zigmond and Cicci, 1968); therefore, it is recommended that, in the future, subjects be chosen who are nine years or older. This will help to assure that maturation is not a factor in changes observed in speech sound discrimination.

Correlation of Pitch Discrimination (PD) Test Data with Wepman Test Data. The correlation of scores on the PD Test with those on the Wepman test was low but positive. Therefore, it was concluded that there is a small but positive relationship between the ability to discriminate pitches and the ability to discriminate speech sounds. In the research literature, the focus seems to be on the fact that a small relationship is shown between these two abilities. However, it is the opinion of

this writer that the important point to be noted is: The relationship is positive. This seems to indicate that there is interaction between pitch discrimination and speech sound discrimination which would probably result in improved speech sound discrimination as pitch discrimination is improved. However, the mutual relationship between the two abilities needs to be delineated in a very clear-cut form before treatment and/or remediation techniques can be set forth.

Another conclusion drawn from the correlation between these two sets of scores was that prediction of scores on the Wepman test cannot be made from scores on the PD Test. In other words, if a subject obtains a high score on the PD Test, it does not necessarily indicate that he will obtain a high score on the Wepman test. The question posed for future research is: Could the PD Test be refined to make it more predictive of scores on the Wepman test? In the opinion of this writer, this question cannot be clarified and answered until the interaction between pitch discrimination and speech sound discrimination is clarified and the mutual causes are defined. Once these answers are discovered, it may be possible to design tests which may be used for prediction and diagnostic purposes.

Pitch Discrimination (PD) Test Data. The reduction of the number of items on the PD Test did not produce a substantial change in the reliability coefficient. For both the uncorrected scores and the corrected scores, there was a moderately strong positive relationship noted between pre- and post-test scores. However, the 60-item (uncorrected) test seemed to be too long for some of the younger subjects, several of whom asked questions such as, "Is the test almost over?" or "Can we stop now?" It may be that, at least for some of the younger subjects,

the length of the test could have caused fatigue and thus lower scores. No effort was made to determine the effect of fatigue, but due to the possibility of this effect, it is recommended that the corrected version of the PD Test be used for any future research.

The correlation of scores between items using guitar as stimulus and those using resonator bells yielded a moderately high positive correlation coefficient. Therefore, it was concluded that one stimulus was as adequate as the other for the purposes of this test. This causes one to consider the question of whether the use of the two different instruments as stimuli may have caused lower scores on the test; i.e., the necessity of having to adjust from one timbre to another could have had a detrimental affect on scores. Further research on the use of this test may include an attempt to determine whether the use of guitar as stimulus is more suitable than resonator bells as compared to the use of both instruments.

The sampling techniques of the present study were questioned since there was statistically significant testing-treatment interaction effect on post-test scores and since the relationship of the variables was changed in the absence of the effects of the covariates. It could be that the "brighter" subjects were given treatment, thus causing the significant results for treatment effects on post-test scores when not controlling for the effects of the covariates. The group means for reading level corroborate this conjecture, as do the group means for grade level although to a slightly lesser degree. The *t*-test results indicated that, when treatment was present, pretesting did not seem to have a significant effect on post-test scores. However, in the absence of treatment, pretesting seemed to have significantly affected post-test scores. The

cross-tabulations comfirmed these findings indicating that, for subjects who did not have treatment, pretesting seemed to cause post-test scores to be higher. Also, for subjects who did not have pretesting, treatment seemed to cause post-test scores to be higher. These results can be summarized as follows: Treatment alone seemed to have about the same affect on post-test scores as pretesting alone. When pretesting and treatment were combined, the effect on post-test scores was about the same as when either treatment or pretesting was present. The combination of the two variables did not significantly, or even noticeably, increase post-test scores. The conclusion which was drawn was that treatment was too specific to cause any additional effects if pretesting was present; i.e., since treatment was basically a subset of the PD Test, treatment and pretesting were essentially equal learning experiences. It appears that the learning which took place may have actually been learning to take the test. Therefore, it is recommended that treatment be changed for any replication of the study. One or more of the following types of training is recommended: (1) discrimination of pairs of pitches in the extreme high and low ranges; (2) discrimination of the timbre of musical instruments, from very different timbres, e.g., violin versus trumpet, to very similar, e.g., upper range of clarinet versus lower range of flute, or trumpet versus cornet; (3) discrimination of pairs of pitches sung by human voice; and (4) the use of synthesizer to produce pure and distorted tones for discrimination.

Wepman Test Data. The analysis of the data obtained from the Wepman Auditory Discrimination Test, Revised (1973), Form IA, revealed that pretesting significantly affected post-test scores. It was believed that the time-lapse between testing sessions (approximately one

month) would negate any retention, therefore, any pretesting effects. Since it is apparent that this was a false assumption, it is recommended that the equivalent form which is available for this test be used in any replication of this study as either the pretest or the post-test.

The non-significant effect of treatment on the post-test scores causes one to question the treatment itself. Since treatment was basically a subset of the PD Test, the learning which took place as a result of treatment was essentially learning to take the PD Test. The small positive correlation between the PD Test scores and the Wepman test scores indicates that a high score on the PD Test does not necessarily indicate a high score on the Wepman test. Therefore, learning to take the PD Test would not necessarily cause improvement in scores on the Wepman test. In other words, knowing how to take the PD Test did not give subjects a broader base of information from which to draw in taking the Wepman test. Therefore, significant improvement on the Wepman test would not be observed.

Response to Test Items. It is generally agreed that verbal responses are not totally accurate indications of auditory perception. This has been a criticism of tests of speech sound discrimination, reading comprehension, etc., which require verbal responses. For this reason, it was felt that motor indications of responses would perhaps give a more accurate indication of what the subject was actually hearing. However, many of the subjects evidenced difficulty remembering which signal indicated which response. Also, it was found that some of the younger subjects, especially, did not seem to comprehend sameness/difference of instrument or dynamics (loudness).

Flower (1968) suggests a hierarchy of auditory perception subskills. Lerner (1971) refers to Flower when discussing problems in testing and teaching:

> First, in both testing and teaching, each auditory subskill becomes contaminated with demands of other learning processes. A second difficulty has been that some children who are successful in academic performance fail certain auditory subtests. Third, the relationship between training in an auditory subskill and academic improvement has not been clearly established. (p. 135)

All of the subjects of the present study were experiencing academic difficulty in at least one area: reading. Nevertheless, an inherent problem with both tests was the fact that subjects were required to recall a motor response as well as to use the auditory subskills of auditory awareness (attention), auditory memory (of words or tones), auditory integration (from auditory stimulus to motor response) and auditory sequencing (of words or tones). If each of these abilities could be isolated for research and for remediation, and if further research demonstrates that training using music is effective for improving these subskills as well as speech sound discrimination, then music should be used as a primary tool in the remediation of auditory problems in LD children.

Implications

At present, precise measurement of auditory subskills and processes is complicated by limited knowledge of the psychological and neurological processes involved. Therefore, it is felt by this writer that the present study must be regarded as a "pioneering" attempt and that conclusions and inferences drawn must be viewed in this light.

It has been established in the research literature that the ability to discriminate speech sounds develops until the ninth year (Wepman, 1960, 1961; Weaver and Rutherfore, 1974; Zigmond and Cicci, 1963).

Although age did not significantly affect post-test scores on the Wepman test in the present study, results of research indicate that age significantly affects the ability to discriminate speech sounds as measured by the Wepman test.

> Standardization research [for the Wepman test] has confirmed the developmental nature of the acquisition of the discrimination [of speech sounds] through the eighth year for all but a few children. (Wepman, 1973, p. 5)

The significant effects of age on the post-test scores of the PD Test imply a developmental nature in the acquisition of the discrimination of pitches. This developmental nature also needs to be carefully researched and defined.

The main implication of this study centers on this conclusion: There is a positive, although small, correlation between pitch discrimination and speech sound discrimination. This relationship needs to be clearly and throughly delineated through research in the areas of neurology, psychology of learning, psychoneurology, speech and music therapy. An explicit delineation of the relationship between pitch discrimination and speech sound discrimination, of the development of the acquisition of pitch discrimination ability, and of the relationship between the development of the ability to discriminate pitches and the development of the ability to discriminate speech sounds would give the music therapist the basis from which to develop more explicit tools for use in conjunction with the speech therapist and the special educator. The full meaning of the results found and the conclusions drawn from this study can only become evident in view of the findings of this future research.

Presently the music educator, music therapist and speech therapist may use training in pitch discrimination to help to focus the child's attention on differences he hears in sound. This information should be used as a tool to help the child generalize the attention he has learned to speech sound discrimination and, therefore, to the academic skills of reading and spelling.

The majority of the children involved in the treatment activities of the present study seemed to enjoy the activities using music. This observation points out the need for LD children to experience music as a learning medium (Welsbacher, 1975). Specific music experiences of the type used in this study and those recommended for use in future reserach should be provided in the curriculum for the LD child.

References

Bannaryne, A. The transfer from modality perceptual to modality conceptual. In H. K. Smith, (Ed.), Perception and reading, Proceedings of the 12th Annual Convention, International Reading Association. Newark, Del.: International Reading Association, 1968, 12(4), 7-16.

Bateman, B. The efficacy of an auditory and a visual method of first grade reading instruction with auditory and visual learners. In H. K. Smith, (Ed.), Perception and reading, Proceedings of the 12th Annual Convention, International Reading Association. Newark, Del.: International Reading Association, 1968, 12(4), 105-112.

Bergendal, B. I., & Talo, E. S. The responses of children with reduced phonemic systems to the Seashore Measures of Musical Talents. Folia Phoniatrica, 1969, 21, 20-38.

Berman, J. R. The use of music for a nonverbal reading prototype: An investigation of auditory-visual processing in poor and good readers. Paper presented at the Annual Meeting of the National Conference on Language Arts in the Elementary School (8th, Atlanta, Ga., March 5-7, 1976), 1976. (ERIC Document Reproduction Service No. ED 120 699)

Bradley, W. H. Some relationships between pitch discrimination and speech development. Laryngoscope, 1959, 69, 422-237.

Butler, K. G. Auditory perceptual training. Acta Symbolica, 1972, 3, 123-125.

Campbell, D. T., & Stanley, J. C. Experimental and quasi-experimental design for research. Chicago: Rand McNally, 1963.

Chalfant, J. C., & King, F. S. An approach to operationalizing the definition of learning disabilities. Journal of Learning Disabilities, 1976, 9, 228-243.

Cruickshank, W. M. Myths and realities in learning disabilities. Journal of Learning Disabilities, 1977, 10, 51-64.

Dawkins, A. C. The effects of music and instruction on auditory discrimination test scores of disadvantaged preschool students (Doctoral dissertation, The Catholic University of America, 1973). Dissertation Abstracts International, 1974, 34, 4862A. (University Microfilms No. 74-5075)

Flower, R. M. The evaluation of auditory abilities in the appraisal of children with reading problems. In H. K. Smith (Ed.), Perception and reading, Proceedings of the 12th Annual Convention, International Reading Association. Newark, Del.: International Reading Association, 1968, 12(4), 21-24.

Gearheart, B. R. Learning disabilties: Educational strategies. St. Louis: C. V. Mosby, 1973.

Hurwitz, I., Wolff, P. H., Bortnick, B. D., & Kokas, K. Nonmusical effects of the Kodaly music curriculum in primary grade children. Journal of Learning Disabilities, 1975, 8, 167-174.

Johnson, D. J., & Myklebust, H. R. Learning disabilities: Educational principles and practices. N.Y.: Grune and Stratton, 1967.

Kerlinger, F. N. Foundations of behavioral research. N.Y.: Holt, Rinehart and Winston, Inc., 1964.

Kottler, S. B. The identification and remediation of auditory problems. Academic Therapy, 1972, 8, 73-86.

Kranyik, M. A. Music can help. Grade Teacher, 1970, 87(8), 60; 62; 64.

Kuper, E. C. Speech training through musical ear-training for pitch deficient children having articulatory defects. Journal of Auditory Research, 1972, 12, 168-172.

Lerner, J. W. Children with learning disabilities. Boston: Houghton Mifflin Company, 1971.

Madsen, C. K., & Geringer, J. M. Choice of televised music lessons versus free play in relationship to academic improvement. Journal of Music Therapy, 1976, 13, 154-162.

Madsen, C. K., Madsen, C. H., Jr., & Michel, D. E. The use of music stimuli in teaching langugage discrimination. In C. K. Madsen, R. D. Greer, & C. H. Madsen, Jr. (Eds.), Research in music behavior: Modifying music behavior in the classroom. N.Y.: Teachers College Press, 1975.

Marshall, E. D. Teaching materials for children with learning disabilities. In W. M. Cruickshank & D. P. Hallahan (Eds.), Perceptual and learning disabilities in children, Vol. 1: Psychoeducational practices. Syracuse, N.Y.: Syracuse University Press, 1975.

McDonald, C. W. Problems concerning the classification and education of children with learning disabilities. In J. Hellmuth (Ed.), Learning Disorders (Vol. 3). Seattle, Wash.: Special Child Publications, 1968.

McIntyre, K. A. Motivating early primary grade children to learn computation, reading, and manuscript writing utilizing music as a catalyst. (Doctoral dissertation, University of Massachusetts, 1975). Dissertation Abstracts International, 1975, 36, 3360A-3361A. (University Microfilms No. 75-27,600)

Mercer, C. D. Fergnone, C., & Wolking W. D. Definitions of learning disabilities in the United States. Journal of Learning Disabilities, 1976, 9, 376-386.

Morency, A. Auditory modality, research and practice. In H. K. Smith (Ed.), Perception and reading, Proceedings of the 12th Annual Convention, International Reading Association. Newark, Del.: International Reading Association, 1968, 12(4), 17-21.

Morency, A., & Wepman, J. M. Early perceptual ability and later school achievement. Elementary School Journal, 1973, 73, 323-327.

Movsesian, E. A. The influence of teaching music reading skills on the development of basic reading skills in the primary grades. (Doctoral dissertation, University of Southern California, 1967). Dissertation Abstracts International, 1968, 28, 3078A (University Microfilms No. 68-1199)

Rechner, J., & Wilson, B. A. Relation of speech sound discrimination and selected language skills. Journal of Communication Disorders, 1967, 1, 26-30.

Rejto, A. Music as an aid in the remediation of learning disabilities. Journal of Learning Disabilities, 1973, 6, 286-295.

Sears, W. W. Processes in music therapy. In E. T. Gaston (Ed.), Music in therapy. N.Y.: Macmillan, 1968.

Sommers, R. K., Meyer, W. J., & Furlong, A. K. Pitch discrimination and speech sound discrimination in articulatory defective and nornal speaking children. Journal of Auditory Research, 1969, 9, 45-50.

Steele, A. L. Music in a special way. Children Today, 1973, 2(4), 8-11.

Swartz, G. A., & Tracy, N. L. Introduction. In G. A. Swartz & N. L. Tracy (Eds.), Language-learning system and learning disability. N.Y.: Simon and Schuster (Selected Academic Readings), 1972.

Texas Education Agency. Administrative guide and handbook for special education. Bulletin 711 (Rev. ed.). Austin: Texas Education Agency, 1973.

United States. Congress. House. An act to extend programs of assistance for elementary and secondary education and for other purposes. Pub. L. 91-230, 91st Cong., 1st sess., 1970, H.R. 514.

United States. President. Proposed rulemaking. Education of handicapped children. Assistance to states. Federal Register, 29 November 1976, 41(230), 52403-52407.

Vaughn, R. W., & Hodges, L. A statistical survey into a definition of learning disabilities: A search for acceptance. Journal of Learning Disabilities, 1973, 6, 658-664.

Vernetti, C. J., & Jacobs, J. F. Effects of music used to mask noise in learning disabilities classes. Journal of Learning Disabilities, 1972, 5, 533-537.

Weaver, S. W., & Rutherford, W. L. A hierarchy of listening skills. Elementary English, 1974, 15, 1146-1150.

Weiner, P. S. Auditory discrimination and articulation. Journal of Speech and Hearing Disorders, 1967, 32, 19-28.

Wepman, J. M. Auditory discrimination, speech and reading. Elementary School Journal, 1960, 60, 325-333.

Wepman, J. M. The interrelationship of hearing, speech, and reading. The Reading Teacher, 1961, 14, 245-247.

Wepman, J. M. The modality concept--Including a statement of perceptual and conceptual levels of learning. In H. K. Smith (Ed.), Perception and reading, Proceedings of the 12th Annual Convention, International Reading Association. Newark, Del.: International Reading Association, 1968, 12(4), 1-6.

Wepman, J. M. Auditory imperception: A perceptual-conceptual developmental construct. In B. B. Wolman (Ed.), Manual of child psychopathology. N.Y.: McGraw-Hill, 1972.

Wepman, J. M. Auditory discrimination test (Rev. ed.), with manual. Los Angeles: Western Psychological Services, 1973.

Wepman, J. M. Auditory perception and imperception. In W. M. Cruickshank & D. P. Hallahan (Eds.), Perceptual and learning disabilities in children, Vol. 2: Research and theory. Syracuse, N.Y.: Syracuse University Press, 1975.

Welsbacher, B. Music for the learning disabled. In R. M. Graham (compiler), Music for the exceptional child. Reston, Va.: Music Educators National Conference, 1975.

Zigmond, N. K., & Cicci, R. Auditory learning. Belmont, Calif.: Fearon Publisher, 1968.